

Getting the Lead Out

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Dan Belton: Technology and Manufacturing Group

Mike Garner: Technology and Manufacturing Group

Key Messages

- **Intel is announcing the planned availability of Flip-Chip Packages with Lead-free (Pb-free) Solder Balls**
 - Select Embedded IA Processors for Communications segment in Q2'2004
 - Select CPUs & Chipsets for Desktop and Mobile segments in Q3'2004
 - Intel will have removed the lead content from these flip-chip packages by ~ 95%*
- **Intel continues to work with the industry to resolve the multiple challenges ahead in order to complete the transition to lead-free**

Agenda

- **Background**
 - The legislative landscape
 - Where is the lead and where it is being removed
 - Intel's progression toward lead-free
- **Industry Transition Complexity**
- **Intel's Customer and Industry Enabling Approach**
- **Intel's Flip-Chip Package Transition to Lead-free**
- **Summary**
- **Questions**

The Legislative Landscape

Asia

- **Japan** - White Goods Recycling Act... Established lead reduction targets
- **China** - Proposal to adopt legislation similar to EU RoHS Directive with China's "Management Methods" released by the Ministry of the Information Industry in March 2004 with effective date 1 July 2006

United States

- Several States considering bans on the same list of materials and potentially others, e.g., California, Massachusetts

European Union

- Restriction of Hazardous Substances (RoHS) - Effective 1 July 2006
- Bans the use of Cadmium, Hexavalent Chromium, **Lead (Pb)**, Mercury, PBB (Polybrominated Biphenyls), and PBDE (Polybrominated Diphenyl Ethers) in electronic products
- RoHS includes banned material exemptions on some products and applications

Intel is working to develop a solution that will be in compliance with all the legislations in the various geographies

Terminology

- **Use of the term lead-free in the electronics industry. Lead-free means ...**
 - **Lead has been eliminated where required by legislation**
 - **Some products and applications are exempt from the materials ban.**

Lead in PCs – Where is it ?



CRT Monitor ~900 g (2 lbs)

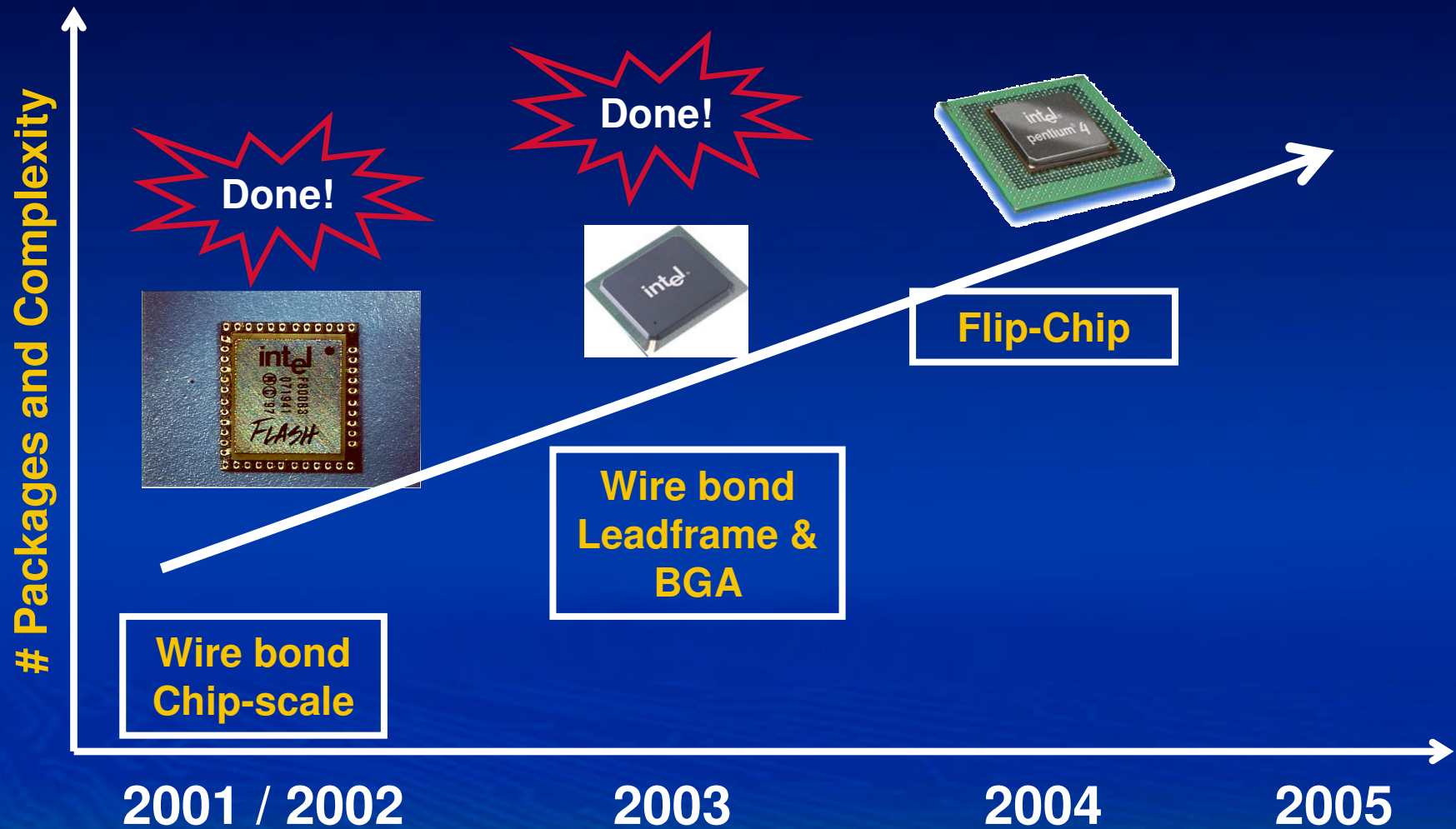
Printed Circuit Board 5-10 g
Microprocessor ~ 0.5 g

Peripherals 2-3 g

For comparison:

- ❖ House key ~0.1-0.3 g
- ❖ 35" CRT TV = 5000 g (11 lbs)
- ❖ Car battery = 9000 g (20 lbs)

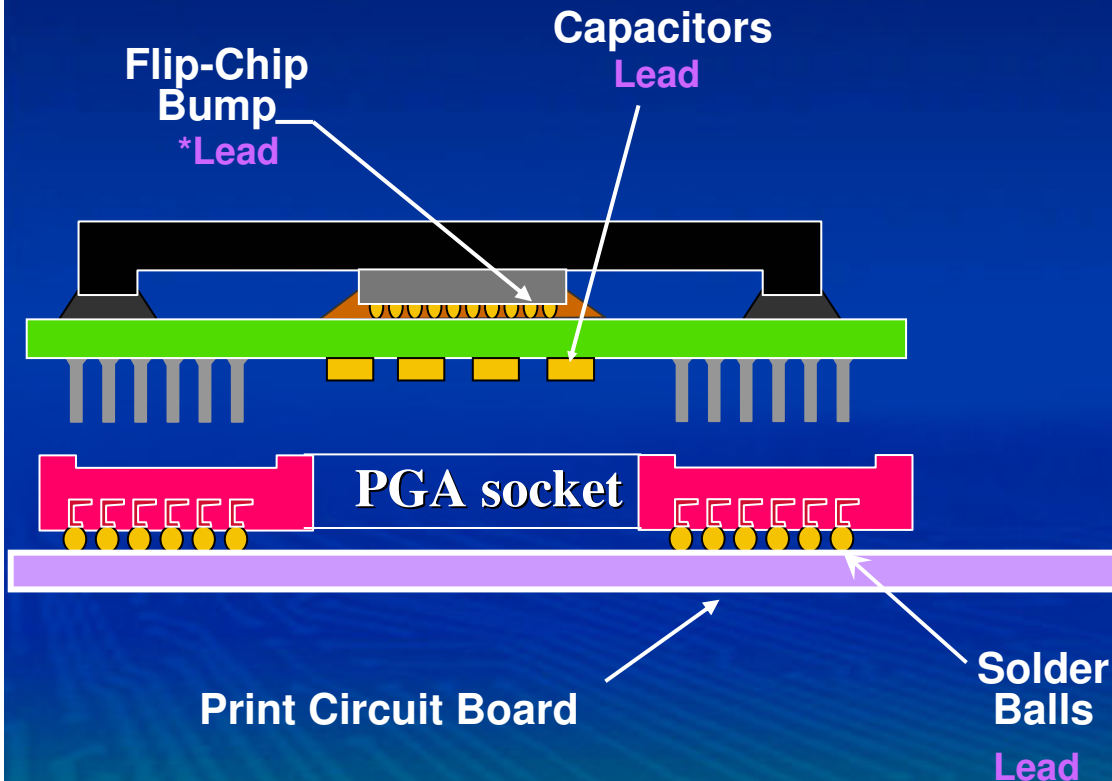
Intel Lead-free Technology Progression



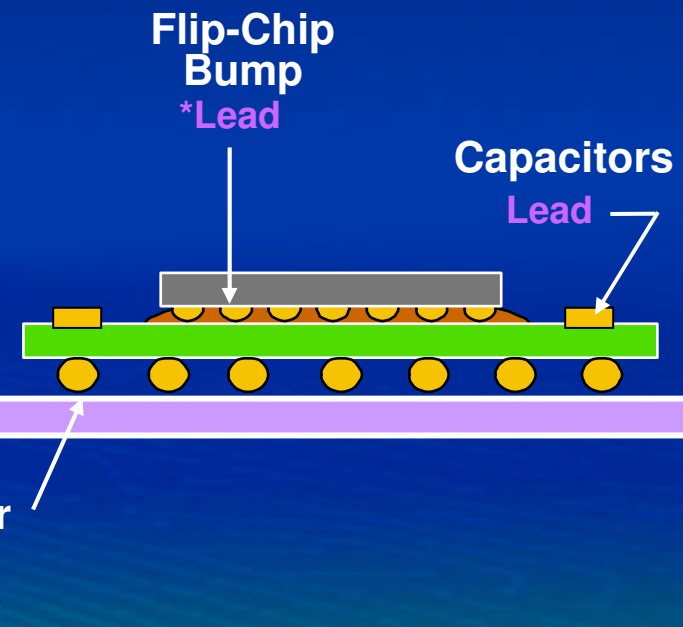
Flip-Chip Technology is the Next Phase

Where's the Lead in Industry's Flip-Chip Packaging?

Flip-Chip Pin Grid Array (FC-PGA)



Flip-Chip Ball Grid Array (FC-BGA)



*Note: Flip-Chip bump is high melting temperature SnPb (tin-lead) solder

Lead-free Alloy Soldering Temperatures

SnPb Soldering

Lead-free Soldering
(Sn4.0Ag0.5Cu)

Max. Temp Tolerance
of Components ~ 235 C

Peak Reflow temp to
allow for process
variations ~ 220C

Min Reflow Temp for
reliable Solder Joint ~ 200C

SnPb mp = 183 C

Peak Reflow temp to
allow for process
variations ~ 260C

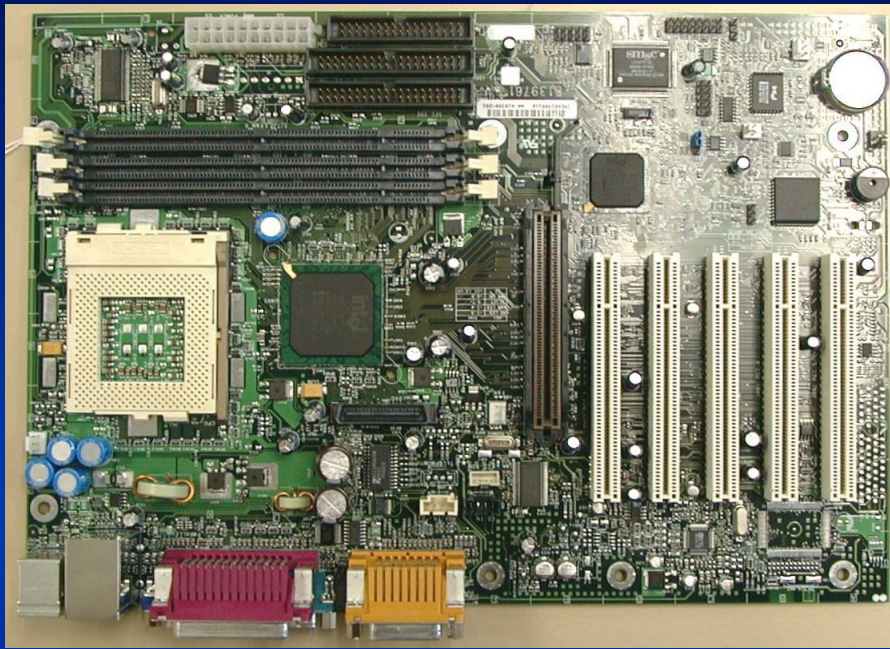
Min Reflow temp for reliable
Solder Joint ~ 235C

SnAgCu mp =
217 C

Components must be able
to withstand 260C
for lead-free SMT
Reflow Soldering

Industry Lead-free Transition Complexity

PC Platform (Example)



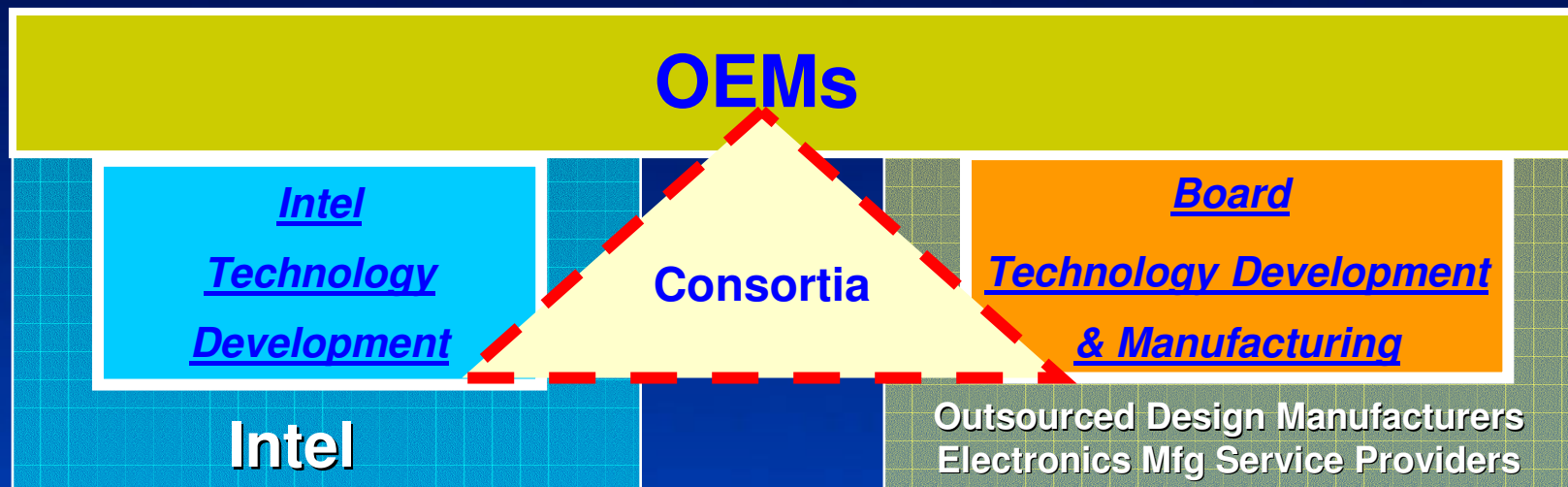
Huge Number of Components

- CPU
- Chipsets
- Ethernet Controllers
- Various other IC's
- Connectors
- Passives (capacitors, resistors, etc.)
- Many others ...

Complexity:

- Simultaneous availability of lead-free components
- Compatibility/reliability of lead-free components
- Board process manufacturability

Intel's Customer & Industry Enabling Approach



- **Industry Enabling Program**

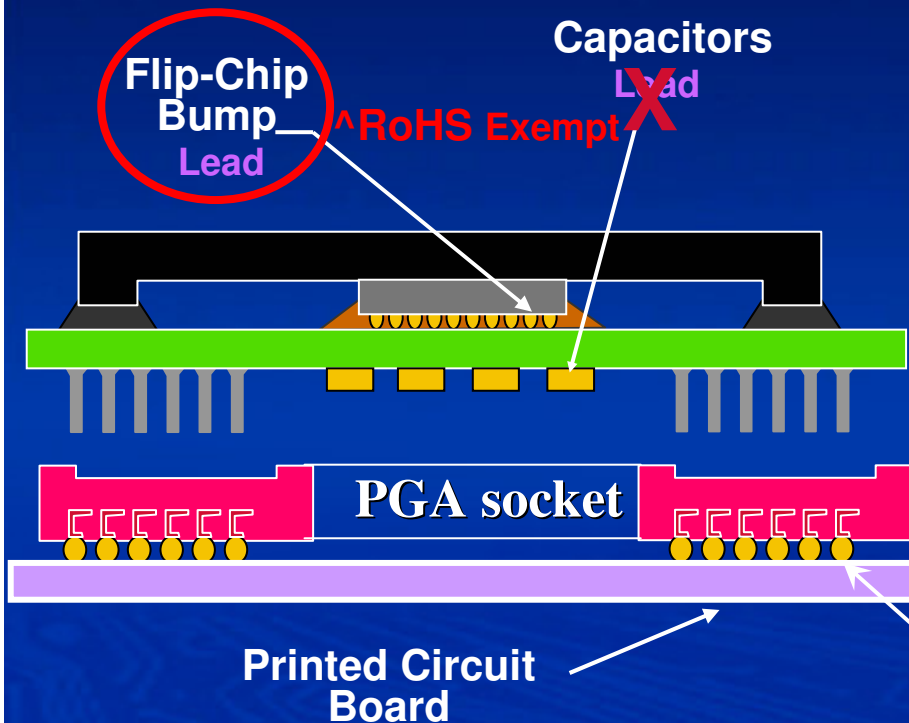
- Validation Test Vehicles
- Samples (mechanical, engineering / functional)
- Board technology process
- Customer and industry education

- **Global Consortia Activities**

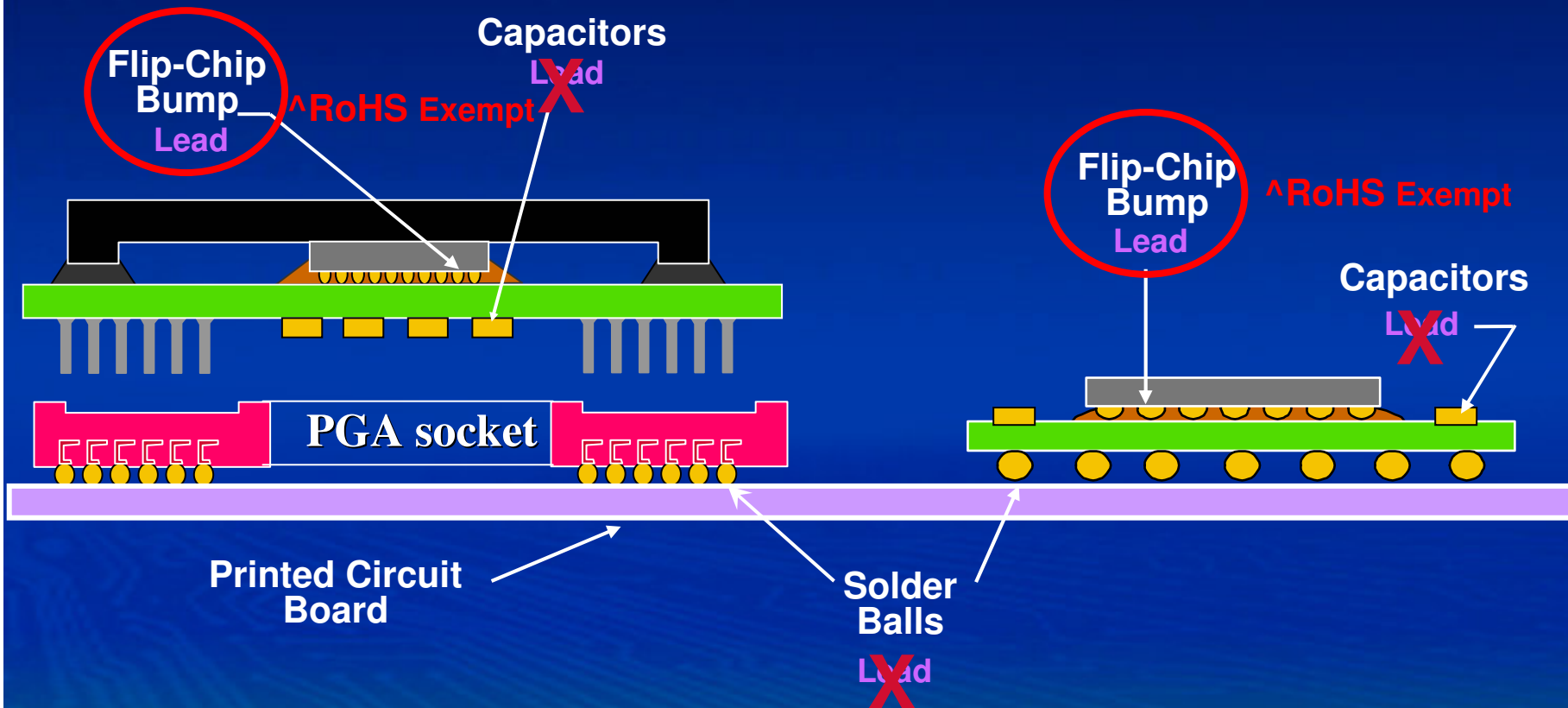
- HDPUG, IPC, JEDEC, JEITA via JEDEC, ITRI (Taiwan), and NEMI
- Ensure technical viability of the legislation
- Develop the necessary standards for this complex industry transition

Eliminating the Lead in Intel Components

Flip-Chip Pin Grid Array (FC-PGA)



Flip-Chip Ball Grid Array (FC-BGA)

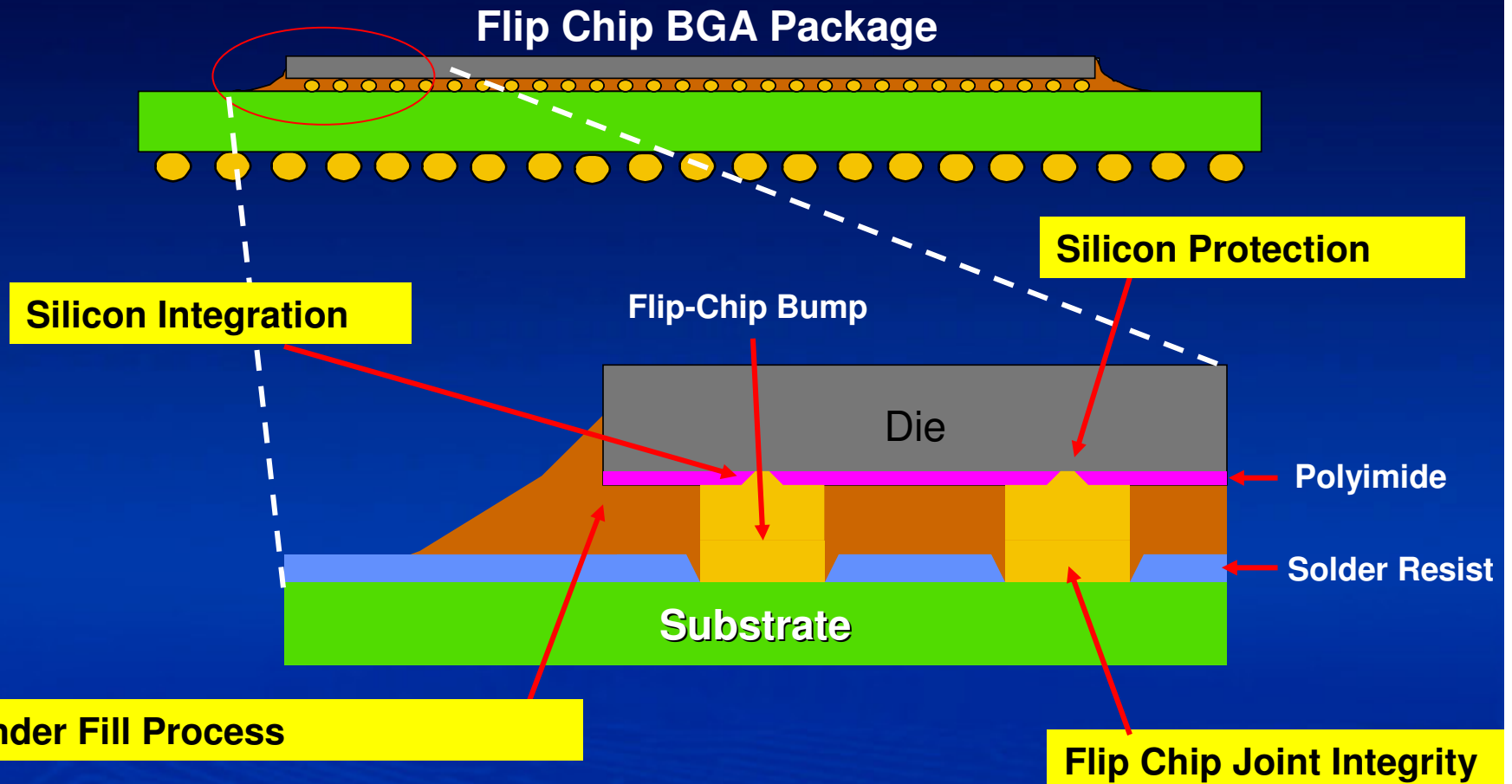


***95% of the Lead Content Removed from Flip-chip Packages**
*Percentage based on weight



^Industry is seeking clarification on high melting temperature Sn-Pb solder exemption

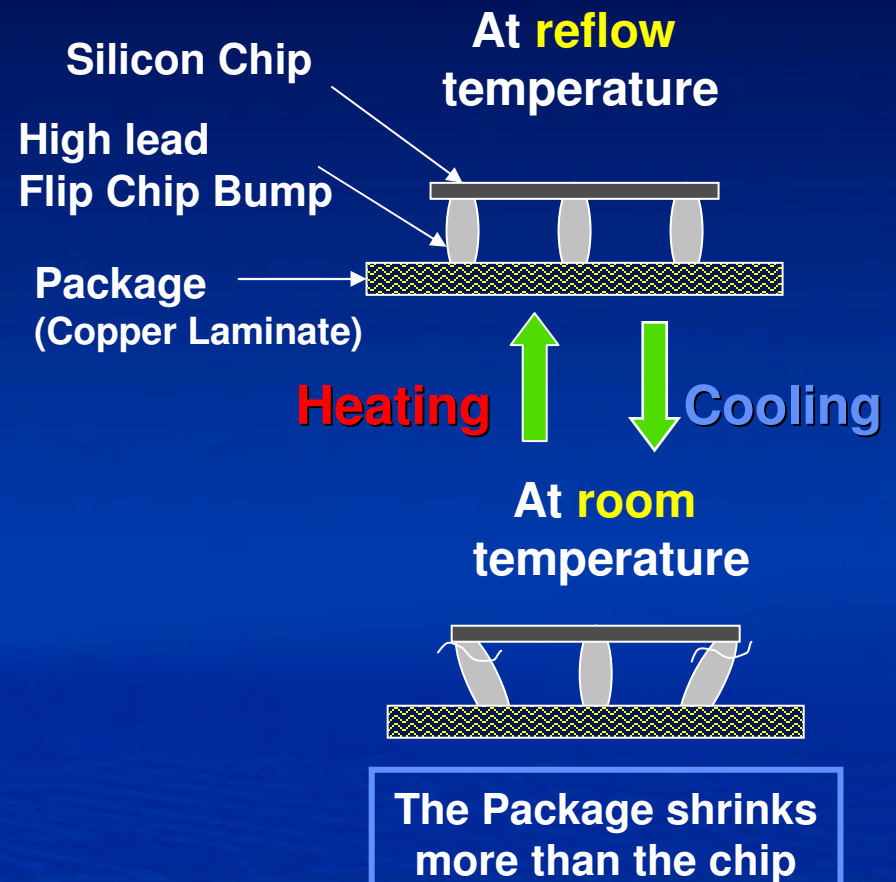
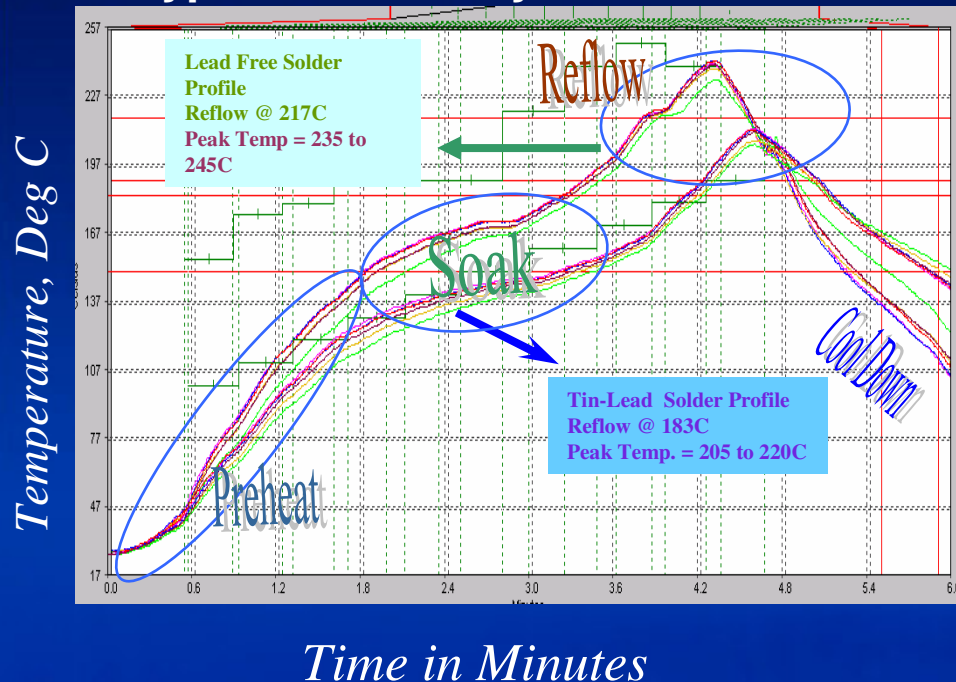
Lead-free Flip-Chip Package Technology Challenges



Many Challenges exist to remove the remaining 5% of lead

Integrated Assembly Challenges

Typical Assembly Reflow Profile



Intel continues to work with the Industry to develop new technologies that meet performance and reliability requirements needed to complete the transition to lead-free (if possible)

Announcing Flip-Chip Technology with Lead-free Solder Balls in 2004

2003



**DT/
Mobile**



**Communications
(Embedded IA)**

2004

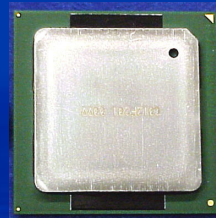
Prescott/Grantsdale



Dothan/Alviso



Plumas



2005

Transition to Lead-free

- Reliability at higher lead-free processing temperatures
- Lead-free Solders & board process
- Dual line items on many products: SnPb and Lead-free solder balls to meet customer needs

- Select Embedded IA Processors for Communications segment in Q2'04
- Select CPUs & Chipsets for Desktop and Mobile segments in Q3'04



Summary

- Intel is announcing the availability of Flip-Chip Packages with lead-free solder balls
- Select CPUs & Chipsets for Desktop, Mobile and Embedded IA Processors for Communications segments in 2004
- Intel is supporting this transition with a unique customer enabling program
 - Lead-free product/platform roadmaps communicated to customers
- Intel continues to work with the industry to resolve the multiple challenges ahead in order to complete the transition to Lead-free



Note: All products, dates, and figures are preliminary, for planning purposes only, and subject to change without notice

**For further information on Intel's lead-free
products, please contact your Intel Field
Sales Representatives**

For further information on Intel's silicon technology and Moore's Law, please visit the Silicon Showcase at www.intel.com/research/silicon

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Questions ?